

IN THE SPECIFICATION:

Please amend the specification as follows:

On page 1, please replace the paragraph beginning on line 4:

This patent application is related to US Patent Applications 09/731,066 (Docket number 1024-034) 09/801,230 (Docket number 1024-036) and now US Patent 6,622,567, 09/768,858 (docket number ~~1024-0937~~ 1024-037) and now US Patent 6,433,629, 10/215,752 (docket number 1024-037b) which is a divisional of the 6,433,629 Patent, 09/114,106 (Docket number 1024-041) and now US Patent 6,529,127, and US Patent Application 10/379,224, which was a continuation of US Provisional Patent Application 60/362,432, all of which are incorporated herein by reference.

On page 1, please replace the paragraph beginning on line 11:

This patent application claims priority of Provisional Patent Applications 60/412,725 filed on September 23, 2002 and 60/419,994 filed on October 21, 2002, both of which are entitled "Remotely Powered, Remotely ~~Interrogated~~ Interrogated wireless Digital Sensor Telemetry System," and both of which are incorporated herein by reference. This application is a continuation-in-part of those Provisional Patent Applications.

On page 1, please replace the paragraph beginning on the second to last line:

Sensors on civil structures, such as buildings, dams, and bridges and orthopedic implants, such as artificial hips and knees, have been limited because of the need to provide power for sensor operation and interrogation. In many of these applications retrieving sensor data precludes the use of batteries at the sensor or hardwired connections to the sensor. ry Very small spaces where common batteries will not fit, extremely harsh environments where common batteries would fail, and metallic hermetically sealed enclosures that would interfere with electromagnetic communication are among the many environments where sensor data retrieval is difficult.

On page 5, please replace the paragraph beginning on line 16:

FIG. 8a is a schematic block diagram of multiple ~~addressible~~ addressable transponders all being powered by the same reader and all also being powered from the same receiver coil;

On page 8, please replace the paragraph beginning on line 14:

Remote electromagnetic powering with switched reactance communications has been used to power up and read identification codes on Radio Frequency IDentification (RFID) tags. RFID tag 26 has tank circuit 28 with its switched reactance circuit 30. Capacitor 31 of switched reactance circuit ~~circuit~~ circuit 30 is brought into or out of tank circuit 28 under the control of power supply and ID generator 32, as shown in FIG. 1. Switched reactance circuit 30 is powered through on board receiver coil 34 which, along with capacitor 36 makes up tank circuit 28. Receiver coil 34 can be a coil, as shown or it can be an antenna. In this application the phrase receiver coil will be used to cover both. Receiver coil 34 absorbs AC power from nearby radiating reader coil 38 connected to reader 40, as shown in FIGS. 1 and 2a. Reader coil 38 can also be either a coil or an antenna, and the phrase reader coil will be used to cover both. Power supply and ID generator 32 controls the position of switch 42 to determine whether communications capacitor 31 is connected or disconnected from tank circuit 28. Thus, reactance of tank circuit 28 is varied under the control of power supply and ID generator 32 so as to provide the RFID's digital code to reader 40.

On page 9, please replace the paragraph beginning on line 5:

Typically, RFID tags like RFID tag 26 shown in FIG. 1 are designed to respond to interrogation by providing only a specified digital ID code stored in non-volatile ~~memory~~ memory in the tag. Only a small amount of current and a small amount of energy are needed to power RFID tag 26 long enough to send this ID code, typically on the order of 6uA and about 18 to 30 uJ, and this tiny amount of current and energy has been compatible with the amount of current and energy available through on-board receiver coil 34 from nearby radiating reader coil 38.

On page 21, please replace the paragraph beginning on line 1:

In another embodiment, an implant may involve two components, one to measure movement of the other. For example, non-contacting DVRT 132 may be located in one of the implants 133 and used to measure the distance D to the other implant 134, as shown in FIG. 16b. The implants may be across a joint, such as a knee or hip joint. In these applications ~~polyethylene~~ polyethylene component 135 is used to provide a low friction articulation between the two components and across the joint. However, polyethylene component 135 may be subject to wear, and this will result in the two components becoming closer to one another. This relative change in position can be detected by DVRT coils 132 which in turn can be monitored by sensor transponder 136. This wear detection information would be helpful to clinicians and therapists charged with the care of patients having artificial knees and hips. Non-contacting DVRTs are available from

Microstrain, Inc, Williston, Vermont. A similar technique can be used for wear detection in other apparatus, such as friction or cold flow based wear.

On page 22, please replace the paragraph beginning on line 15:

In another embodiment, DVRT core carrier 180 of DVRT 182 is connected to hermetically sealed flexure element 184, as shown in FIG. 18. Core carrier 180 contains ferrite core 186. Flexure element 184 responds to force or pressure, pushing in or pulling out core carrier 180 of DVRT 182 with it as it moves. As ferrite core 186 moves, inductance of DVRT 182 changes, and this change in inductance is measurable by electronics connected to DVRT 182 and can be transmitted externally using switched reactance circuit in sensor ~~transponder~~ transponder 48a, 48c and receiver coil 34' as shown in FIG. 18 and FIGS 2a, 2c. DVRT 182 thus provides a measure of the force or pressure on flexure element or diaphragm 184.

On page 25, please replace two paragraphs beginning on line 1:

As shown in FIG. 8b, once reader 206 is provided nearby sensor transponders 202, sensor transponders 202 receive power transmitted from reader 206 and power turns on for them, as shown in box 210. Sensor 60, 60' can now start acquiring data and storing sensor data in EEPROM data storage 208, as shown in box 211. Microprocessor 54 now directs transmission of its sensor transponder's address and the acquired sensor data, as shown in boxes 212 and 213. Microprocessor 54 then provides a fixed time delay by executing a software loop at a rate determined by clock cycles of its internal RC clock circuit 214. It executes this loop a number of times determined by a stored number that sets the fixed delay, thus providing the programmed magnitude of the fixed time delay (FIG. 2a-2c), as shown in box 215. Microprocessor 54 also provides a random time delay using a random number generator software routine to generate a random number to ~~to~~ apply to the same software loop, as shown in box 216 of FIG. 8b, to provide the random time delay. At each step in the software loop microprocessor 54 decides whether the fixed or random number has been reached. If not, microprocessor 54 continues to cause delay. If the number has been reached, microprocessor 54 causes repetition of the entire process starting with sensor 60, 60' providing another measurement and storing its sensor data, as shown in box 211.

In another embodiment multiple sensor transponder circuits 218 can be provided with a single receiver coil 34' and receiver tank circuit 28, as shown in FIG. 8c. Switched reactance circuit 220 is connected to each ~~addressible~~ addressable sensor transponder circuit 218. Each ~~addressible~~ addressable sensor transponder circuit 218 includes microprocessor 54, power supply elements 50 and 52, sensors 60, 60' and other elements shown in FIGS. 2a, 2c. Switched reactance circuit 220 in each ~~addressible~~ addressable

sensor transponder circuit 218 transmits both address and sensor data. MUX 56 in microprocessor 54 sequentially provides data to data storage in microprocessor 56 from individual sensors 60, 60', such as thermocouples 222. From the sequence of data arrival, the specific thermocouple 222 providing the data can be determined. Software in an external computer can be used to provide this level of sensor identification based on sequence of arrival. Providing multiple sensor circuits 218 with a single receiver coil saves space, allowing many sensors to be in a single small package. Alternatively, RF transmitters can be provided with each sensor transponder 218 as shown in FIG. 2b. Two way communication can also be provided with ASK or FSK demodulators, as shown in FIGS. 8a-8c.

On page 29, please replace the paragraph beginning on line 20:

The present inventors found that one improvement is to use synchronous demodulation reader 260, as shown in FIG. 10a to obtain recovered data similar to that shown in FIG. 9d but with higher signal to noise ratio, allowing reader 40 to be further away from sensor transponder 48a, 48c. In this method, synchronous demodulator 261 replaces diode D1. Synchronous demodulator 261 is an active device that facilitates removal of distortion products and phase noise before the signal is filtered and amplified, thus improving signal to noise ratio. Synchronous demodulator 261 includes gain polarity switch 262 and operational amplifier 263. Gain polarity switch 262 is an electronic switch controlled by the carrier from oscillator 253, including its signal, distortion products and phase noise. The output from operational amplifier 263 is rectified at the sum of the input frequencies, or about twice the frequency of oscillator 253. The output from operational amplifier 263 also includes a DC shift that depends on the magnitude of the loading introduced by sensor transponder 48a, 48c. The result of the synchronous demodulation process is an output signal with less noise and distortion than would be obtained with the diode of FIG. 9a, as shown in FIG. 10b.

On page 33, please replace the paragraph beginning on line 1:

The present inventors provide shunt calibration, as shown in FIGS 2a-2c, in which known resistance or known reactance 310 is switchably connected across a sensor, such as one of the legs of sensor bridge circuit 312, as shown in FIGS. 2a-2c. Sensors, such as a strain sensor, torque transducer, thermistor thermistor, DVRT, variable capacitor device, or any other sensor can be calibrated in this manner. The shunt reactance can be a known capacitance or a known inductance. If the sensor is a DC sensor, than a shunt resistance is used. If the sensor is an AC sensor, than a shunt reactance is used.